***RUBBER BAND CATAPULT LAB***

**READ THIS BEFORE YOU LOSE POINTS …**

 You will lose significant points if you shoot rubber bands at anyone or sabotage another group’s work.

Your grade will be partially based on the accuracy of your final shots.  This means you must be careful to shoot the catapult in the same exact way each time and to spot and measure very carefully.

If you miss class during this project, you will have to make the project up outside of class time.

**Roles**

\*Launcher – Pulls back and shoots the rubber bands. Be sure to pull back and release consistently each time. This means for every launch you must pay attention to how you load, stretch, and release the rubber band.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*Spotter – Watch where the rubber band first hits the ground and mark the spot. Be sure to notice where it first hits the ground and not where it rolls or scoots to.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*Measurer – Measure the horizontal distance the rubber band traveled. When you measure distance, be sure to measure **accurately** and in **centimeters**. Measure from the end of the catapult (where the rubber band releases) to the front of the rubber band (the end closest to the catapult).

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*Recorder/Reporter– Accurately record the data and find the averages. Is responsible for asking the teacher about group questions.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

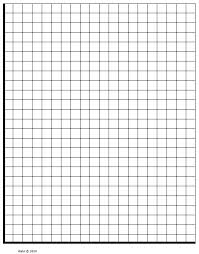
**Goals:**

* Launch rubber bands from the catapult and accurately gather data for distance traveled vs. angle of launch and distance traveled vs. cm of pullback.
* Create models that fit the data.
* Use the models to examine and answer questions about the flight of the rubber bands.
* Use the models to accurately predict launch behavior of the rubber band and hit the target.

**Data Set 1: Constant Pullback, Varying Angle**

**A.** Band size \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Force of Launch (fixed) =\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- | --- | --- |
| **ANGLE** | **Horizontal Distance Trial 1** | **Horizontal Distance Trial 2** | **Horizontal Distance Trial 3** | **Mean Horizontal Distance** |
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**B.** Graph your data:

**C.** Make a Model

* Use your calculator to perform quadratic regression and find the equation that models your data.
  + Go to “STAT” and choose “1: Edit…”. Enter your angles in list 1 (L1) and your distances in list 2 (L2). You will have 4 data points for each angle (the three separate trials and the average), which means that you will enter each angle 4 times in L1.
  + Go to the “Y=” screen. Clear out any equations. Go up to the top of the screen, put your cursor on “Plot 1” and press “Enter” to turn on the scatter plot.
  + Go to “Window”. Make xmin=0, xmax=90, xscl=10. Make ymin=0, ymax=500 and yscl=50.
  + Hit “Graph”. You should see a scatter plot that looks like your graph in part B.
  + Go to “STAT” and right arrow over one to “CALC”. Choose option “5:QuadReg” and press enter twice.
  + Record the resulting equation. This is the model of your data for distance traveled based on angle of launch for a specific pullback.

Equation : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**D.** Interpret the model

1. Find the vertex.
2. **Explain the meaning** of the vertex in this situation
3. Find the two solutions (x-intercepts/zeros) for this situation.
4. **Explain** the meaning of the solution that matters in this situation.

**E.** Make predictions based on your data:

1. Based on your model, what distance will the rubber band travel for the following angles of launch: (Show work)

20 degrees?

35 degrees?

71 degrees?

1. Based on your model, what angle of launch would you have to use to achieve the following horizontal distances: (Show work)

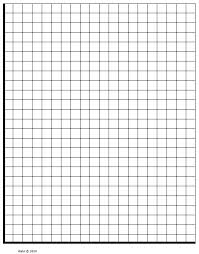
100 cm?

200 cm?

**Data Set 2: Constant Angle, Varying cm of pullback**

**A.** Band size \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Angle of Launch (fixed) = \_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cm pull back** | **Horizontal Distance Trial 1** | **Horizontal Distance Trial 2** | **Horizontal Distance Trial 3** | **Mean Horizontal Distance** |
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**B.** Graph your data:

**C.** Make a Model

* Use your calculator to perform quadratic regression and find the equation that models your data.
  + This time, L1 will be the cm of pullback and L2 will be still be distance.
  + Go to “Window”. Make xmin=0, xmax=30, xscl=2. Make ymin=0, ymax=500 and yscl=50.
  + Follow the rest of the steps as before.
  + Record the resulting equation. This is the model of your data for distance traveled based on cm of pullback for a specific angle of launch.

Equation : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**D**. Interpret the model

1. Find the vertex.
2. **Explain the meaning** of the vertex in this situation
3. Find the two solutions (x-intercepts/zeros) for this situation.
4. **Explain** the meaning of the solution that matters in this situation.

**E.** Make predictions based on your data:

1. Based on your model, what distance will the rubber band travel for the following cm of pullback: (Show work)

10 cm?

15 cm?

22.5 cm?

1. Based on your model, what force would you have to use to achieve the following horizontal distances: (Show work)

100 cm?

200 cm?

**Test Your Models:**

**Test :** Angle (teacher given)= Cm pullback: \_\_\_\_\_\_\_\_\_\_\_\_ Distance: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Try 1 Try 2

OR

Cm pullback (teacher given) = Angle : \_\_\_\_\_\_\_\_\_\_\_\_ Distance: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Try 1 Try 2

Prize options:

* + Candy
  + HW Pass
  + 5 extra credit points